

CLAIMS

What is claimed is:

1. A method of attaching a first member of one of quartz and a ceramic to a metal member, comprising:
 - creating a hole in said metal member, the hole being smaller in size than the size of the first member over a temperature range;
 - heating the metal member to a temperature sufficient to expand the hole to allow insertion of said first member in the hole;
 - inserting a portion of said first member into said hole; and
 - cooling the metal member to form a joined structure of the first member and the metal member.
2. The method of claim 1, wherein said first member is a substantially cylindrical member.
3. The method of claim 2, wherein creating said hole comprises creating a hole of substantially circular cross-section, having a diameter that is smaller in size than the size of the first member, over the temperature range of the joined structure in use.
4. The method of claim 3, wherein creating said hole further comprises creating said hole such that the diameter of the first member and the diameter of the metal member differ by about 0.1% to about 0.3% of the diameter of the first member.
5. The method of claim 1, further comprising fusing a quartz rod of substantially circular cross-section to a member to thereby form said first member, prior to inserting, and wherein said portion of said first member comprises said quartz rod.
6. The method of claim 3, wherein forming said hole further comprises forming a hole having a diameter that smoothly and progressively reduces in diameter toward the interior thereof, from a diameter at a mouth of the hole of at least the diameter of the first member over said temperature range to said diameter that is smaller in size than said first member in the hole, thereby reducing tensile stress gradients in the first member of the joined structure.
7. The method of claim 3, further comprising forming a finely tapered lip in the metal

member about the mouth of said hole, prior to inserting said portion of said first member.

8. The method of claim 7, wherein said cooling causes deformation of the lip of said metal member about said mouth of said hole, thereby reducing tensile stress gradients in the first member of the joined structure.

9. The method of claim 3, wherein said metal member comprises a metallic proof mass and said first member comprises a portion of a quartz structure of a gravity sensor.

10. In a gravity sensor, a metallic proof mass joined to a quartz structure using the method of claim 1.

11. In the gravity sensor of claim 10, first and second metal plates joined to said quartz structure, in a substantially parallel manner, using the method of claim 1.

12. In the gravity sensor of Claim 10, the quartz structure being joined to a metal enclosure and supported therefrom, using the method of Claim 1.

13. In the gravity sensor of Claim 10, metal stops being joined to said quartz structure to limit the range of movement of said proof mass.

14. The method of claim 1, wherein said metal structure comprises invar.

15. A joined structure comprising:
a metal member having a hole therein;
a first member of one of quartz and a ceramic disposed in said hole, said metal member exerting a compressive stress on said first member, over a temperature range.

16. The structure of claim 15 wherein said first member is substantially cylindrical.

17. The structure of claim 16, wherein said hole is substantially cylindrical.

18. A gravity sensor including the joined structure according to claim 15.

19. The joined structure of claim 15, wherein said first member comprises a first portion and a second portion, fused to said first portion, said second portion being substantially cylindrical and said second portion being disposed in said hole.

20. The joined structure of claim 15, wherein said compressive stress on said first member is less at the mouth of said hole than that at an interior portion of said hole.

21. The joined structure of claim 15, wherein said hole in said metal member smoothly and progressively decreases in size towards the interior hole of said hole.

22. The joined structure of claim 21, wherein a thinly tapered lip about a mouth of the hole of said metal member is deformed.

23. The joined structure of claim 13, wherein said metal member is invar.